A

Patent Application Transmittal

(only for new nonprovisional applications under 37 C.F.R. 1.53(b))

Correspondence Address:
FROMMER LAWRENCE & HAUG LLP
745 FIFTH AVENUE
NEW YORK, NEW YORK 10151
TEL: (212) 588-0800
FAX: (212) 588-0500

Date: October 20, 1999
Attorney Docket No.: 450117-02106

ASSISTANT COMMISSIONER FOR PATENTS
Box Patent Application
Washington, D.C. 20231

Sir:

With reference to the filing in the United States Patent and Trademark Office of an application for patent in the name(s) of:

Hans-Uwe JURGENSEN, Richard STIRLING-GALLACHER

entitled:
RECEIVER ARCHITECTURE FOR A MULTI SCRAMBLING CODE TRANSMISSION CDMA TECHNIQUE

The following are enclosed:

- X Specification (11 pages)
- X 6 Sheet(s) of Drawings
- X 16 Claim(s) (including 3 independent claim(s))
- ___ This application contains a multiple dependent claim

X Our check for $ 800.00, calculated on the basis of the claims as amended by any enclosed preliminary amendment as follows:

Basic Fee, $760.00 ($380.00)	$ 760.00
Number of Claims in excess of 20 at $18.00 ($9.00) each:	-0-
Number of Independent Claims in excess of 3 at $78.00 ($39.00) each:	-0-
Multiple Dependent Claim Fee at $260.00 ($130.00)	-0-
Total Filing Fee	$ 760.00
X Assignment Recording Fee $40.00	$ 40.00

X Oath or Declaration and Power of Attorney
X New X signed ___ unsigned
___ Copy from a prior application (37 C.F.R. 1.63(d))

X Certified copy of each of the following application(s) to substantiate the claim(s) for priority made in the Declaration:

Application No.	Filed	In
98 120 115.5	23 October 1998	Europe

Please charge any additional fees required for the filing of this application or credit any overpayment to Deposit Account No. 50-0320.

Respectfully submitted,

FROMMER LAWRENCE & HAUG LLP
Attorneys for Applicants

By: William S. Frommer
William S. Frommer
Reg. No. 25,506

PATENT
450117-02106

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Hans-Uwe JURGENSEN et al.

Filed : Herewith

For : RECEIVER ARCHITECTURE FOR A MULTI SCRAMBLING CODE TRANSMISSION CDMA TECHNIQUE

745 Fifth Avenue
New York, New York 10151
Tel. (212) 588-0800

EXPRESS MAIL

Mailing Label Number EL250499964US
Date of Deposit October 20, 1999
I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" Service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231

Charles Jackson
(Typed or printed name of person mailing paper or fee)

Charles Jackson
(Signature of person mailing paper or fee)

09420599 . 102099

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Before the issuance of the first Official Action, please amend the above-identified application as follows:

IN THE CLAIMS:

Please amend the claims as follows:

Claim 3, line 1, delete "anyone of claims 1 or 2", and insert --claim 1--;

Claim 5, line 1, delete "anyone of claims 3 or 4", and insert --claim 3--;

Claim 8, line 3, delete "anyone of the preceding claims", and insert --claim 1--;

Claim 12, line 1, delete "anyone of claims 10 or 11" and insert --claim 10--;

Claim 14, line 1, delete "anyone of claims 12 or 13" and insert --claim 12--;

REMARKS

The claims have been amended to eliminate multiple dependencies. The filing fee has been calculated based upon these amendments to the claims.

Respectfully submitted,

FROMMER LAWRENCE & HAUG LLP
Attorneys for Applicants

By
William S. Frommer
Reg. No. 25,506
Tel. (212) 588-0800

PATENT
450117-02106

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR LETTERS PATENT

TITLE: RECEIVER ARCHITECTURE FOR A MULTI SCRAMBLING CODE TRANSMISSION CDMA TECHNIQUE

INVENTORS: Hans-Uwe JURGENSEN, Richard STIRLING-GALLACHER

William S. Frommer
Registration No. 25,506
FROMMER LAWRENCE & HAUG LLP
745 Fifth Avenue
New York, New York 10151
Tel. (212) 588-0800

Sony International (Europe) GmbH
Sony Ref.: S98P5112EP00/PAE98-058TRDE
P21370EP

Receiver architecture for a multi scrambling code transmission CDMA technique

The present invention relates to a receiver and a receiving method for detecting information symbols transmitted according to a CDMA technique, wherein the information symbols have been respectively spread with an identical spreading code and scrambled with different scrambling codes.

CDMA (Code Division Multiple Access) transmitting systems are known from the state of the art. According to one CDMA technique, after the modulation (symbol mapping), the symbols are spread by a so-called spreading sequence or spreading code. After spreading the resulting data stream is scrambled by a scrambling sequence or a scrambling code. The thus resulting data stream, which has been spread and scrambled, is then power-amplified and sent over a communication channel. The reverse procedure is effected at the receiving side.

In Figure 3 an example for a transmission system comprising scrambling and spreading is shown. In the example of Figure 3 only the downlink communication channel 26 from a base station 24 to a mobile station 25 is shown. The downlink 26 can comprise different channels D_1 ,...., D_N. Each channel comprises channelisation (spreading) 28, 30 and scrambling 29, 31. According to the state of the art in one link, as for example the downlink 26 as shown in Figure 3, only one scrambling sequence (scrambling code) and several different spreading codes (often referred to as channelisation codes) are used depending upon the data rate and services required. The drawback of this approach is that only certain types of channelisation codes can be used together and the highest data rate is constrained by the length of the shortest channelisation code. This is especially true when codes of different rates are used.

From WO96/05668 A1 and EP-A-565 506 techniques for multiple access coding for radio communication is known. According to these documents information symbols are spread using orthogonal or bi-orthogonal code words. This spread information symbols are assigned a unique scramble mask that is taken from a set of scramble masks having selected correlation properties. The set of scramble masks is selected such that the correlation between the modulo-2 sum of two scramble masks with any codeword is a constant magnitude independent of the codeword and the individual mask being compared. According to one embodiment of WO 96/05668 A1, when any two masks are summed using modulo-2 sum arithmetic, the Walsh transformation of that sum results in a maximally flat Walsh spectrum. For cellular radio telephone systems using subtractive CDMA demodulation techniques, a two-tier ciphering system ensures security at the cellular system level by using a pseudorandomly generated code key to select one of the scramble masks common to all of the mobile stations in a particular cell. As according to these techniques one common scramble mask is used for all mobile stations in a particular cell, the above-cited drawback arises that only certain types of channelisation codes can be used together limiting the number of available channelisation (spreading) codes.

The generation of spreading codes by a code tree is known from Adachi, "Tree-structured generation of orthogonal spreading codes with different lengths for forward link of DS-CDMA mobile radio", Electronics Letters, January 1997, Vol.33, No.1, page 27, 28.

A RAKE receiver is for example shown and explained in US-A-5677930. Therefore regarding the principles of the RAKE receiving technology and the meaning of the specific expressions such as "RAKE tap" etc. reference is made to said document.

Fig. 8 shows a receiving technique known from the prior art. It is assumed that one scrambling code and a plurality of spreading codes is used to transmit data according to a CDMA technique. Therefore received data is passed to a plurality of RAKE receivers 40, 41. The provision of a plurality of RAKE receiver, however, represent a disadvantage regarding the complexity and thus the producing costs of the entire receiver structure.

All known receiver techniques can only cope with transmission systems utilizing only one scrambling code within one link (uplink or downlink). The present invention, however, deals with CDMA transmission systems utilizing two or more scrambling codes within one link for which up to now no receiver structure has been proposed in the state of the art.

Therefore it is the object of the present invention to provide for a receiving technique adapted to cope with CDMA transmission systems utilizing one spreading codes and two or more scrambling codes within one link (uplink or downlink).

The object as set forth above is achieved by means of the features of the independent claims. The dependent claims develop further the central idea of the present invention in a particularly advantageous manner.

Therefore, according to the present invention, a receiver for detecting information symbols transmitted according to a CDMA technique is provided, wherein the receiver is adapted to cope with received information symbols which have been spread with identical spreading codes and scrambled with different scrambling codes. The receiver thereby comprises a modified RAKE receiver.

According to the present invention furthermore a mobile telecommunications device is provided comprising a receiver as set forth above wherein the mobile telecommunications device can be a portable mobile station.

According to the present invention furthermore a method for receiving and detecting information symbols transmitted according to a CDMA technique is provided. A method is adapted to cope with the information symbols which have been respectively spread with an identical spreading code and scrambled with different scrambling codes. According to the method of the present invention a plurality of descrambling steps is provided for descrambling an input data bit stream respectively with different descrambling codes. In a modified RAKE receiving step the output of the despreading step is passed to a number of parallel streams which are then multiplied by the different

number of parallel streams which are then multiplied by the different descrambling codes before multiplication by the estimated channel coefficients. The number of RAKE receiver outputs therefore corresponds to the number of scrambling codes used.

Further aspects, advantages and features of the present invention will now be explained by means of embodiments of the present invention and with reference to the enclosed figures of the drawings.

Figure 1 shows a general view of a wireless transmission system,

Figure 2 shows the spreading and scrambling respectively for a downlink communication channel and a uplink communication channel between a base station and a mobile station of the wireless transmission station as shown in Figure 1,

Figure 3 shows the channelisation (spreading) and scrambling in a downlink communication channel between a base station and a mobile station according to the prior art,

Figure 4 shows the plurality of cells in the transmission system,

Figure 5 shows an application of the present invention to provide for higher data rate services,

Figure 6 shows a receiver according to the present invention designed for a multi scrambling code CDMA technique,

Figure 7 shows the internal structure of a RAKE receiver modified according to the present invention, and

Figure 8 shows a known receiver for a CDMA technique utilizing a plurality of spreading codes and only one scrambling code per link.

A transmission system according to the present invention will now be explained generally with reference to Figure 1. As shown in Figure 1, different data can be transmitted in a wireless manner. The data to be transmitted can comprise voice data from a telephone 1, 23, digital video data, for example, from a video camera 5 to be transmitted to a monitor 20 and other digital information data, as for example, data from a computer 6 to be transmitted to another computer 19. The analog voice data from a telephone 1 are A/D-converted 2, voice coded 3 and then supplied to a channel encoder 4. The data, for example, from a video camera 5 or from the computer 6 are also supplied to the channel encoder 4. The different data, for example, the voice data and the video data can be transmitted simultaneously. The data from the channel encoder 4 are given to a interleaver 7 and then supplied to a modulator 8 providing for a symbol mapping. The modulated data from modulator 8 are then spread 9 and scrambled 10, which will be explained later on in detail. The spread and scrambled data are amplified 11, and then transmitted over a wireless transmission path 12.

On the receiving side, the received data bit stream is downconverted in a baseband downconvertor 13. The downconverted data output from the baseband downconvertor 13 are digitized in an A/D converter 14 and input to correlator 16'. The correlator 16' can be a cyclic correlator or a taped delay line. The incoming received chip stream is correlated by the correlator 16' by all of the different cyclic shifts. By means of the correlation the correlator 16' detects correlation peaks representing delays corresponding to estimated path delays $\tau 1$, $\tau 2$, ... of a multipath propagation channel. The amplitudes of the detected correlation peaks represent the amplitudes and phases of the estimated paths. The output signals of the correlator 16' are both supplied to a channel estimator 15 and a descrambling/despreading unit comprising a RAKE receiver 16. The descrambling/despreading unit 16 comprising a RAKE receiver is supplied with estimated tap coefficients (channel estimates) from the channel estimator 15. The output of the RAKE receiver in the descrambling/despreading unit 16 is passed through a deinterleaver 17, a channel decoder 18, a voice decoder 21 and is then D/A converted in a D/A converter 22. Finally the analog data is output on a terminal such as a telephone 23. Obviously digital data can be supplied directly from the channel decoder 18 for example to a video monitor 20 or a computer terminal 19.

With reference to Figure 2, particularly the scrambling procedure will now be explained in detail.

In Figure 2 the communication between a base station 24 and a mobile station 25 is shown. Particularly the downlink channel 26 from the base station 24 to the mobile station 25 and the uplink channel 27 between the mobile station 25 and the base station 24 are shown. The downlink channel 26 and the uplink channel 27 comprise different subchannels $D_1 \ldots D_N$, $D_{1'} \ldots D_{N'}$. A first subset of the subchannels of the downlink channel 26 can for example be used for voice data and other subchannels can be used for the simultaneous transmission of video data. The data from the base station 24 are channelised (spread) with different spreading codes $C_{channel\ 1}, \ldots, C_{channel\ N}$, which are mutually orthogonal or bi-orthogonal 28, 30. The spread data are then scrambled 29, 31 with scrambling codes $C_{scramble\ 1}, \ldots, C_{scramble\ M}$. Therefore scrambling codes which are different, but need not to be mutually orthogonal or bi-orthogonal, are used within the same link, for example, the downlink 26. (The orthogonality requirements are satisfied by the spreading codes.)

For the uplink 27, either the same scrambling codes $C_{scramble\ 1}, \ldots, C_{scramble\ M}$ as in the case of the downlink 26, or another group of scrambling codes $C_{scramble\ 1'}, \ldots, C_{scramble\ M'}$ or, as generally the uplink channel 27 demands for the same high bit rate as the downlink channel 26, even just one scrambling code can be used.

As it has already been set forth above, the downlink channel 26 or the uplink channel 27 can comprise subchannels for video and/or voice transmission. Different scrambling codes can be allocated for the scrambling of the channels demanding for a high bit rate, as it is the case, for example, for the transmission of video data. For transmission of, for example, voice data, only one scrambling code can be used.

Regarding the details of the spreading and scrambling process, particularly the modulo-2 sum operation for the scrambling at the transmission side and the multiplying operation for the descrambling at the reception side, the above-cited documents WO 96/05668 A1 and EP-A-565 506 are incorporated by reference. Particularly Figures 1

and 2 in the corresponding description (page 14 to page 19) of WO 96/05668 A1 are incorporated by reference.

The spreading codes can be generated for example by a code tree. This technique is known from Adachi, "Tree-structured generation of orthogonal spreading codes with different lengths for forward link of DS-CDMA mobile radio", Electronics Letters, January 1997, Vol.33, No.1, page 27, 28, which is incorporated herewith by reference.

Orthogonal spreading codes with different lengths can be generated by a tree-structure for orthogonal multiplexing of forward-link code-channels of different data rates in direct sequence code division multiple access DS-CDMA mobile radio. Thereby codes of the same layer of the tree constitute a set of Walsh functions and are orthogonal. Furthermore, any two codes of different layers of the tree structure are also orthogonal except for the case that one of the two codes is a mother code of the other.

As it has already been set forth in the introductory portion, when only one scrambling code (or long code) is used per link, there are restrictions of the combinations of codes which can be used for the orthogonal codes (see Adachi et al.) These restrictions may prevent a user from being allocated to a certain channel. These restrictions are especially important for high data rate users. Furthermore the highest data rate is restricted to the shortest orthogonal code.

As according to the technique set forth above, two or more scrambling codes are assigned to one link (one user), the following advantages are achieved:
- the highest data rate is increased since the data rate can be split over at least two scrambling codes. Therefore a higher data rate service on one link (uplink or downlink) can be provided by using a plurality of scrambling codes within one link. In this way the same channelisation codes (spreading codes) can be reused and a higher data rate can be supported because the highest data rate is restricted by the set of channelisation codes (spreading codes) with the shortest link.

By only using two scrambling codes (M=2) per link (user), the total number of available channelisation codes (spreading codes) can be doubled and the maximum data rate can also be doubled.

Figure 4 shows a symbolized cell distribution of a wireless transmission system. One cell C_1 is surrounded by six other hexagonal cells $C_2,\ldots,C_7$. A total number of, for example, 512 different scrambling codes can be used. To avoid interference between adjacent cells, the total number of 512 scrambling codes can for example be divided by 7 and each cell $C_1,\ldots,C_7$ can be allocated a subset of said scrambling codes. Different users within one cell can use different scrambling codes allocated to the respective cell.

As it has already been set forth above, one scrambling code can be used in conjunction with a set of channelisation codes (spreading codes) depending upon the required data rate and services required. Adjacent base stations can use different scrambling codes and every base station uses a set of scrambling codes to maintain different links in each cell.

To increase the flexibility of code assignment and increase the usage of the codes and the code tree, it is proposed to use as an option more than one scrambling code per link.

Figure 5 shows an application of the technique set forth above. According to Figure 5 the technique is used to provide an increased data rate, for example, for a WCDMA system. To increase the data rate normally in WCDMA one or both of the following approaches are required:

- reduction of processing gain, and
- increase of chip rate (enhanced bandwidth)

By utilizing the scheme as shown in Figure 5 the data rate can be increased by combining more than one scrambling code. The example shows the data rate at 4 Mbit/s, but obviously higher rates can be achieved by using more than one scrambling code.

Now a receiver technology according to the present invention for a transmission system utilizing CDMA modulation, a plurality of spreading codes per link and only one scrambling code per link will be explained with reference to Fig. 6. The receiver technology implements the descrambling and despreading shown in figure 1 and designated by the reference sign 16.

The receiver technology as shown with reference to Fig. 6 is designed to cope with transmission systems utilizing more than one scrambling code per link to alleviate the problem of channelisation code restriction and also to provide a higher data rate service on one link (uplink or downlink). In this way the same channelisation code can be reused and a higher data rate can be supported because the highest data rate is restricted by the set of channelisation codes (spreading codes) with the shortest length. When reusing one and the same channelisation code for spreading the two different data streams transmitted in one link and scrambling these two data streams by two different scrambling codes, the complexity of the receiver can be reduced as shown with reference to Fig. 6 as complex RAKE receivers can be suppressed as according to the present invention only one RAKE receiver 16 is necessary.

With reference to figure 7 the internal structure of a modified RAKE receiver according to the present invention will be explained.

As it has already been explained, the RAKE receiver 16 is supplied (additionally to the information bits) both with delay information $\tau 1$, $\tau 2$, ..., τ_n corresponding to the position of the correlation peaks detected by the correlator 16' and tap coefficients (estimation values) from the channel estimator 15 input to a multiplication circuits 51 of the RAKE receiver 16.

As shown in Fig. 7 the output signals of the correlator 16' are supplied with corresponding delays $\tau 1$, $\tau 2$, ..., τ_n provided by a delay line 42, 43 to a plurality of so called RAKE taps of the RAKE receiver 16. (In figure 8 two RAKE taps are depicted for a schematic representation of the RAKE receiver. Generally the RAKE receiver comprises n RAKE taps and (n-1) delay units, n being an integer larger than 1). The

delays τ1, τ2, ..., τ_n correspond to the estimated delays of the multipath channel as they are detected by the correlator 16'.

In figure 7 two RAKE taps are shown schematically. Generally the receiver comprises n RAKE taps, n being an integer larger than 1. Each of the RAKE taps comprises despreading units 44,45 using common chanelisation codes. The output of the despreading units 44, 45 is respectively divided into a plurality of parallel streams wherein the number of streams corresponds to the number of different scrambling codes used per link. Each of the parallel streams is passed to a corresponding descrambling unit 46, 47, 48, 49 multiplying the output of the despreading units 44,45 by the respective scrambling code used in the stream. In each RAKE tap comprising one despreading unit 44, 45 a set of k descrambling units 46, 47, 48 ,49 is provided, the descrambling units belonging to the same set being respectively supplied with the output of the same despreading unit. k thereby is an integer larger than 1. Each set of k descrambling units 46, 47, 48 ,49 uses the same k descrambling codes used in the link. Therefore in each RAKE tap the output of the respective despreading unit is descrambled with the same set of k different descrambling codes .

The output of the descrambling units 46, 47, 48, 49 is then respectively passed to an adding circuit 50 summing up all chips of a symbol.

The respective outputs of the adding circuits 50 is then passed to multiplying circuits 51 where they are multiplied with the complex conjugate of the estimated channel coefficients supplied from the channel estimator 15. Respectively n (number of RAKE taps) outputs of the multiplying circuits 51 are then combined in one RAKE combiner 52 as shown in figure 52, 53. The RAKE combiner 52,53 output the signals output_1, ..., output_k.

Respectively one RAKE combiner 52, 53 is provided with the output of n, in the shown example two, multiplying circuits belonging to different RAKE taps (different despreading units) but at the same time belonging to streams with descrambling units using the same descrambling code. Therefore, in the example shown in figure 7, k RAKE combiner 52, 53 are provided corresponding to the number of streams of one

RAKE tap and hence to the number k of different scrambling codes used per link. For example, the RAKE combiner 52 combines n outputs of the parallel streams having been descrambled in the descrambling units with the same scrambling code $C_{SCRAMB1}$. The RAKE combiner 53 combines n outputs having been descrambled in the descrambling units with the same scrambling code $C_{SCRAMBk}$.

With other words, on the receiver side, see figure 7, the incoming data is passed to a delay line (two delay units 42, 42 are depicted in figure 8) which forms part of a modified RAKE receiver. From specific delays of the delay line, the signal is despread using the common channelisation codes and then further split into a number of streams corresponding to the number of scrambling codes used in the link. Each stream is then multiplied by the respective scrambling code used in the stream and the resulting signal is passed to the complex conjugate of the estimated channel coefficient supplied from the channel estimator 15 and then passed to a RAKE combiner.

Therefore the present invention provides for the following advantages:
- lower complexity of the receiver structure, and
- more efficient usage of the available RAKE receivers.

Sony International (Europe) GmbH

Sony Ref.: S98P5112EP00/PAE98-058TRDE

P21370EP

Claims:

1. Receiver for detecting information symbols transmitted according to an CDMA technique,

according to which CDMA technique the information symbols are respectively spread with a common spreading code and scrambled with different scrambling codes, on the transmission side,

the receiver comprising:

- at least one despreading unit (44, 45) for despreading an input data bitstream respectively with said common spreading code, and
- a set of k descrambling units (46, 47, 48, 49) per despreading unit (44, 45), k being an integer larger than 1, repectively k descrambling units (46, 47, 48, 49) being supplied with the output signal of one despreading unit (44, 45).

2. Receiver according to claim 1,

characterized in that

a plurality of despreading units (44, 45) is provided and input data are supplied to the despreading units (44, 45) by means of a delay line (42, 43).

3. Receiver according to anyone of claims 1 or 2,

characterized in that

a channel estimator (15) is provided generating channel estimation values.

4. Receiver according to claim 3,

characterized in that

a correlator (16') is provided supplying correlation based data both to the input of the receiver (16) and of the channel estimator (15).

5. Receiver according to anyone of claims 3 or 4, characterized in that it comprises multiplying circuits for multiplying data based on the output of a descrambling unit (46, 47, 48, 49) with the channel estimation values supplied from the channel estimator (15).

6. Receiver according to claim 5, characterized in that a plurality of RAKE combiner (52, 53) is provided being respectively supplied with the output of n multiplying circuits (51) associated with different despreading units (44, 45) but with descrambling units (46, 47, 48, 49) using the same descrambling code, wherein n is the number of RAKE taps and larger than 1.

7. Receiver according to claim 6, characterized in that a number k of RAKE combiner is provided, k being the number of different scrambling codes used per link and being larger than 1.

8. Mobile communications device, characterized in that it comprises a receiver according to anyone of the preceding claims.

9. Mobile communications device, characterized in that it is a mobile station for a CDMA transmission system.

10. Method for detecting information symbols transmitted according to an CDMA technique,

according to which CDMA technique the information symbols are respectively spread with a common spreading code and scrambled with different scrambling codes, on the transmission side,

the method comprising the following steps:

- despreading (44, 45) an input data bitstream respectively with said common spreading code, and
- a set of k descrambling step (46, 47, 48, 49) per despreading step (44, 45), k being an integer larger than 1, repectively k descrambling steps (46, 47, 48, 49) being supplied with the output of one despreading step (44, 45).

11.Method according to claim 10,
characterized in that
a plurality of despreading steps (44, 45) is provided and input data are supplied to the despreading steps (44, 45) after having been passed through a delay line (42, 43).

12. Method according to anyone of claims 10 or 11,
characterized in that
a channel estimation values are generated.

13. Method according to claim 12,
characterized by
a correlation step (16') for supplying correlation based data both to the receiving step (16) and to the channel estimation value generation step (15).

14. Method according to anyone of claims 12 or 13,
characterized by
the step of multiplying data based on the output of a descrambling unit (46, 47, 48, 49) with the channel estimation values supplied from the channel estimation value generation step (15).

15. Method according to claim 14,
characterized by
a plurality of RAKE combining steps (52, 53) respectively supplied with the output of n multiplying steps (51) associated with different despreading steps (44, 45) but with descrambling steps (46, 47, 48, 49) using the same descrambling code, wherein n is the number of RAKE taps and larger than 1.

16. Method according to claim 15,

characterized in that

a number k of RAKE combining steps is provided, k being the number of different scrambling codes used per link and being larger than 1.

Sony International (Europe) GmbH
Sony Ref.: S98P5112EP00/PAE98-058TRDE
P21370EP

Abstract

To provide a higher data rate service on one link, it is possible to use more than one scrambling code per link. In this way, the same channelisation code can be reused and a higher data rate can be supported because the highest data rate is restricted by the set of channelisation codes with the shortest length. When reusing one and the same channelisation code for spreading the two different data streams transmitted in one link and scrambling these two data streams by two different scrambling codes, the complexity of the receiver will be reduced. Therefore, the two data streams are spread with one and the same channelisation code. After this, each of these data streams is scrambled with a different scrambling code.

(Fig. 7)

FIG 1

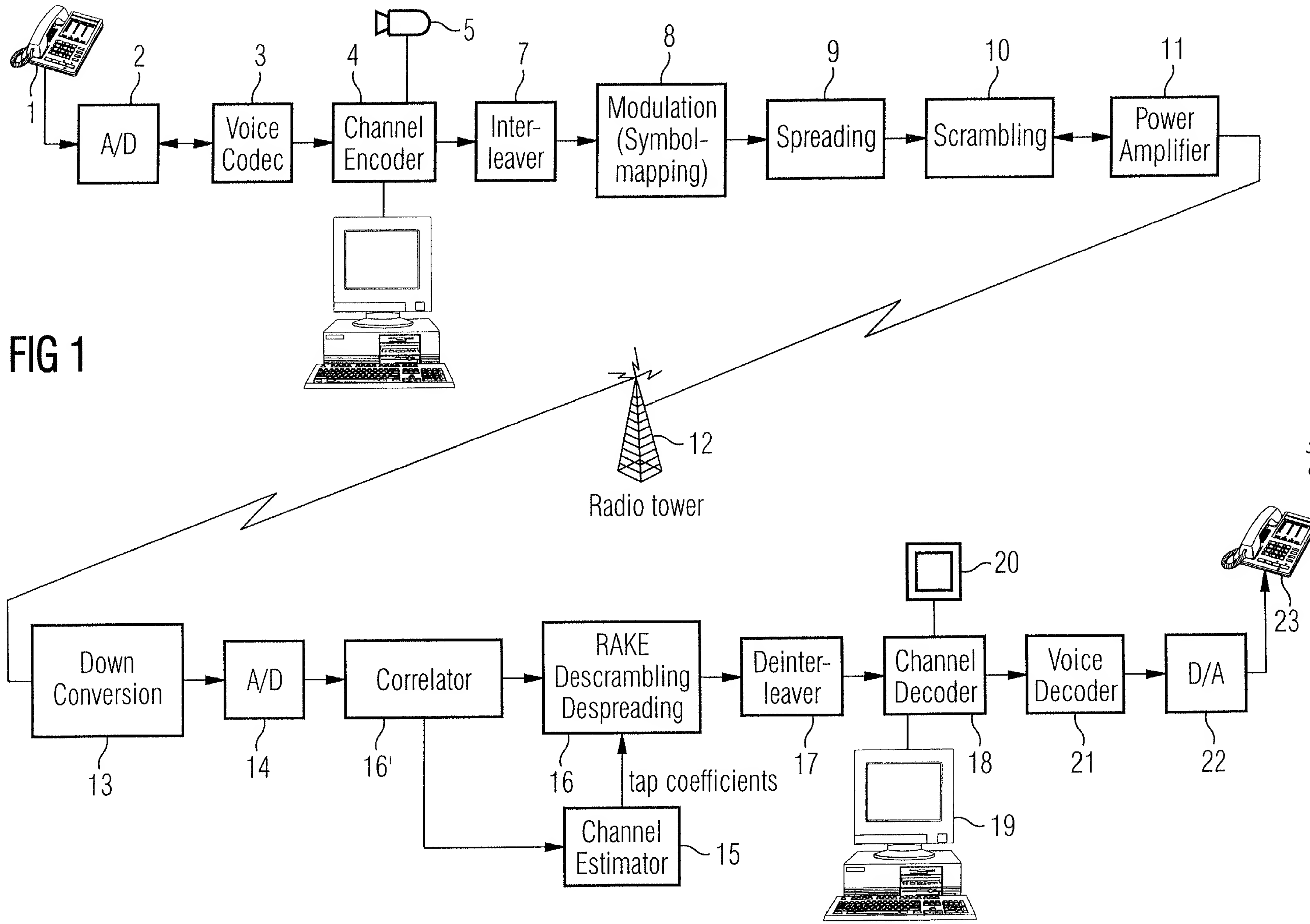

1
2
A/D
3
Voice Codec
4
Channel Encoder
5
7
Inter-leaver
8
Modulation (Symbol-mapping)
9
Spreading
10
Scrambling
11
Power Amplifier
12
Radio tower
Down Conversion
13
A/D
14
Correlator
16'
RAKE Descrambling Despreading
16
tap coefficients
Channel Estimator
15
Deinter-leaver
17
Channel Decoder
18
19
20
Voice Decoder
21
D/A
22
23

FIG 2

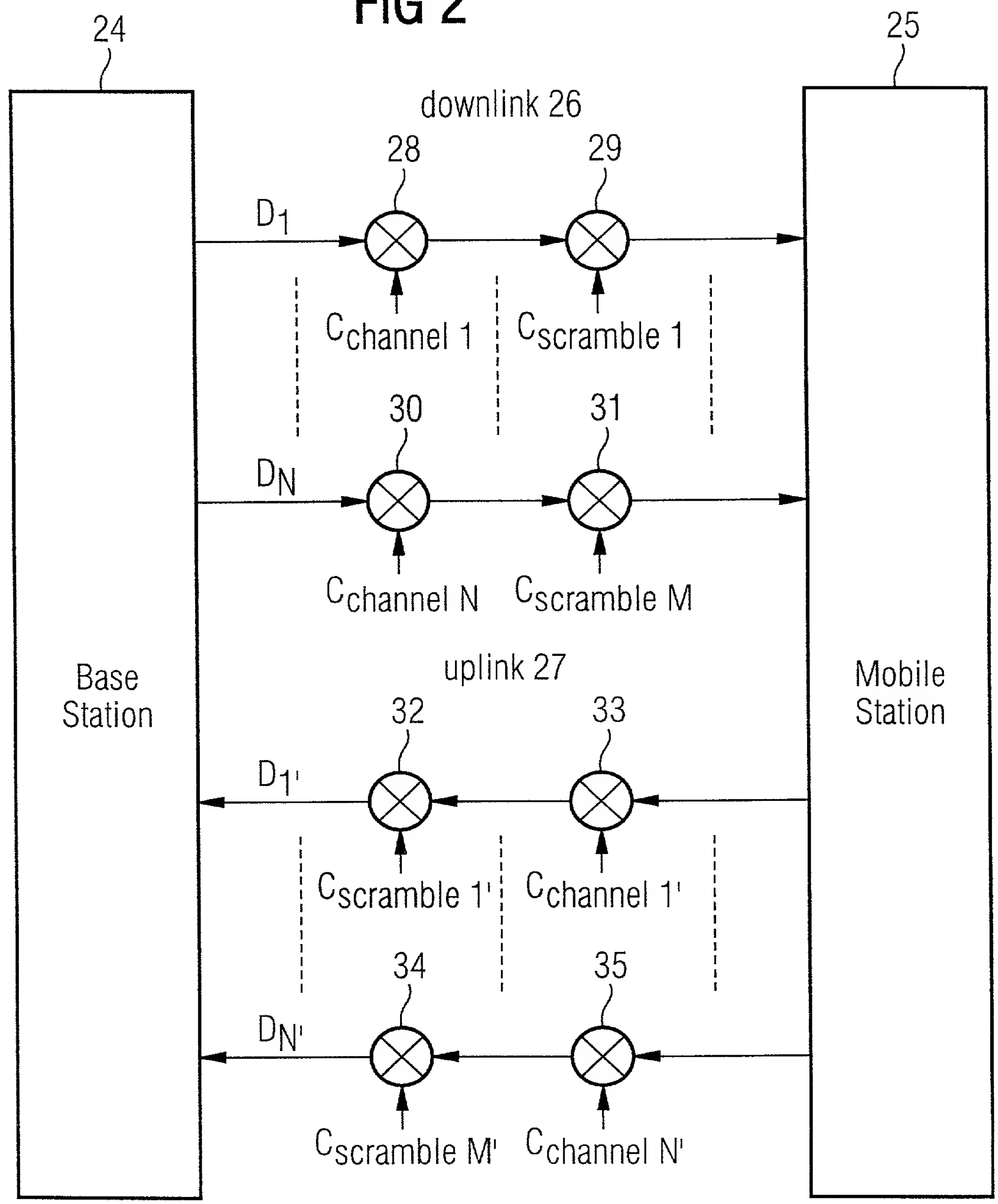

24
25
downlink 26
28
29
D_1
$C_{channel\ 1}$
$C_{scramble\ 1}$
30
31
D_N
$C_{channel\ N}$
$C_{scramble\ M}$
Base Station
Mobile Station
uplink 27
32
33
$D_{1'}$
$C_{scramble\ 1'}$
$C_{channel\ 1'}$
34
35
$D_{N'}$
$C_{scramble\ M'}$
$C_{channel\ N'}$

FIG 3

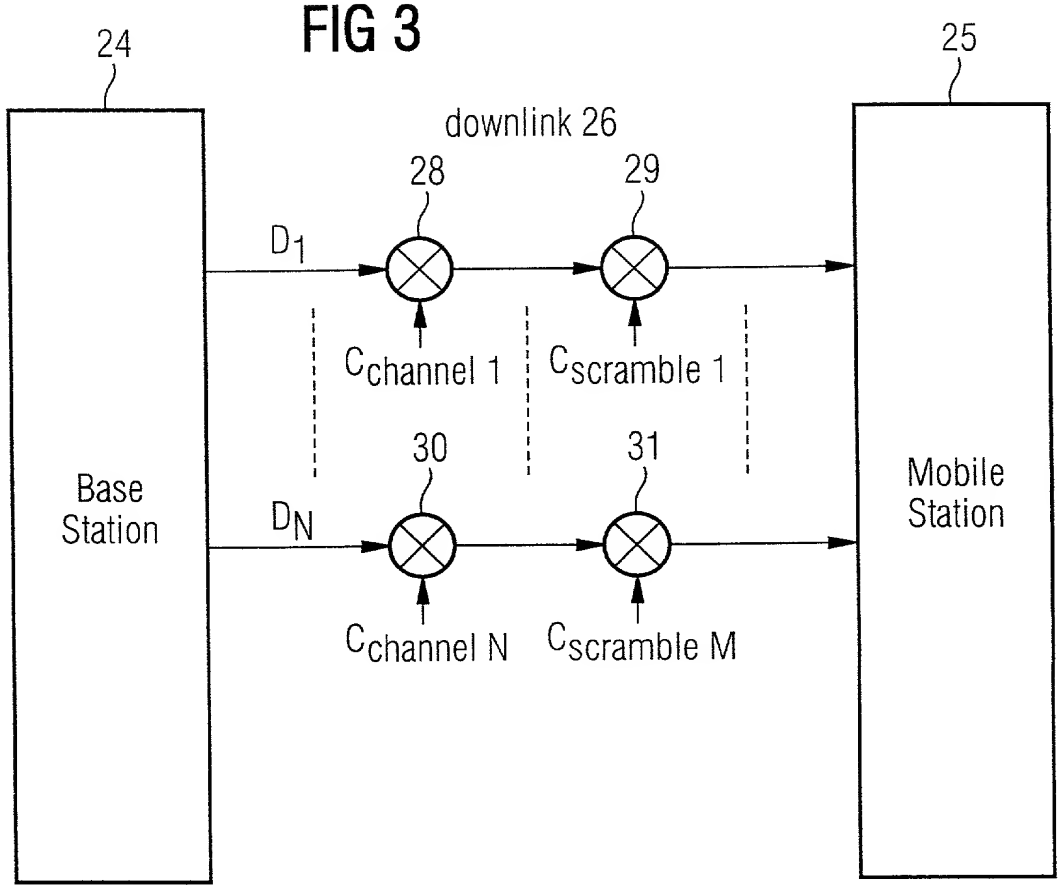

24
25
Base Station
downlink 26
28
29
D_1
$C_{channel\ 1}$
$C_{scramble\ 1}$
30
31
D_N
$C_{channel\ N}$
$C_{scramble\ M}$
Mobile Station

FIG 4

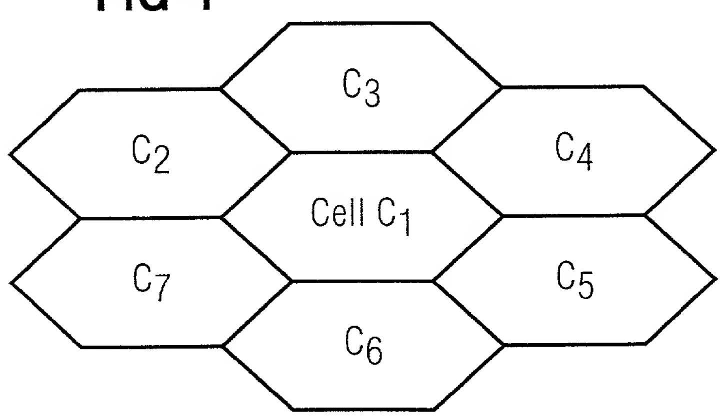
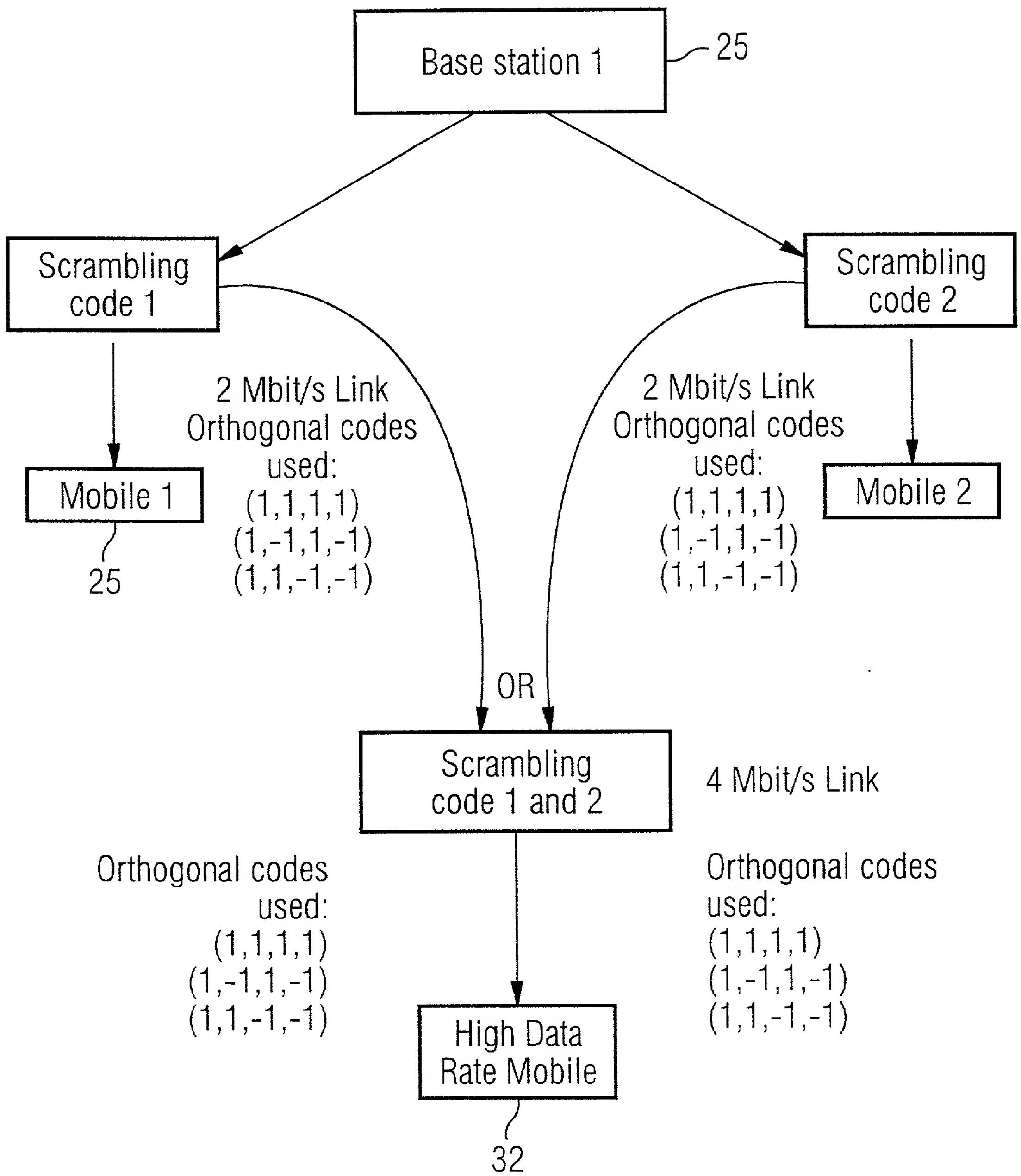

C_3
C_2
C_4
Cell C_1
C_7
C_5
C_6

FIG 5



Base station 1
25
Scrambling code 1
Scrambling code 2
Mobile 1
25
2 Mbit/s Link
Orthogonal codes used:
(1,1,1,1)
(1,-1,1,-1)
(1,1,-1,-1)
2 Mbit/s Link
Orthogonal codes used:
(1,1,1,1)
(1,-1,1,-1)
(1,1,-1,-1)
Mobile 2
OR
Scrambling code 1 and 2
4 Mbit/s Link
Orthogonal codes used:
(1,1,1,1)
(1,-1,1,-1)
(1,1,-1,-1)
Orthogonal codes used:
(1,1,1,1)
(1,-1,1,-1)
(1,1,-1,-1)
High Data Rate Mobile
32

FIG 6

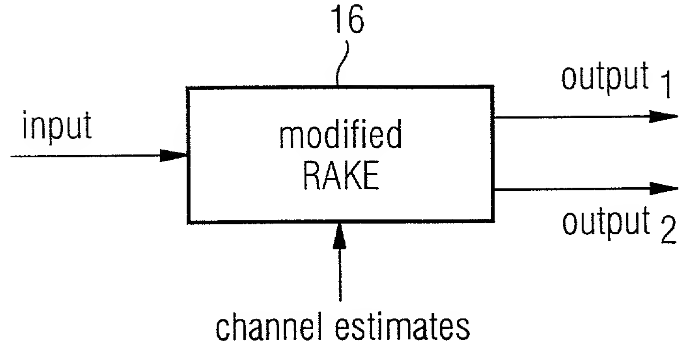
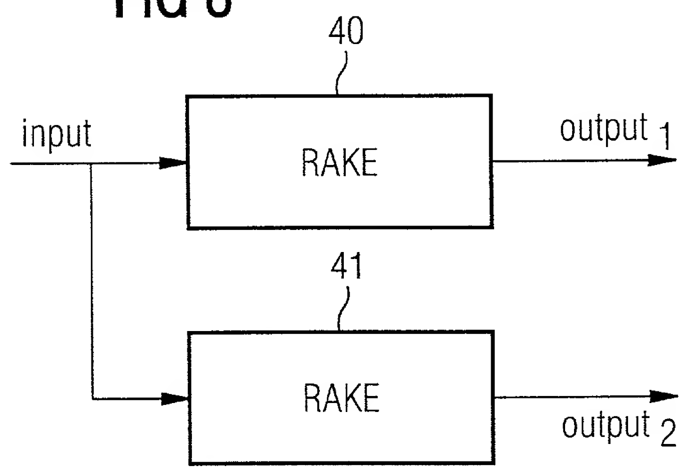
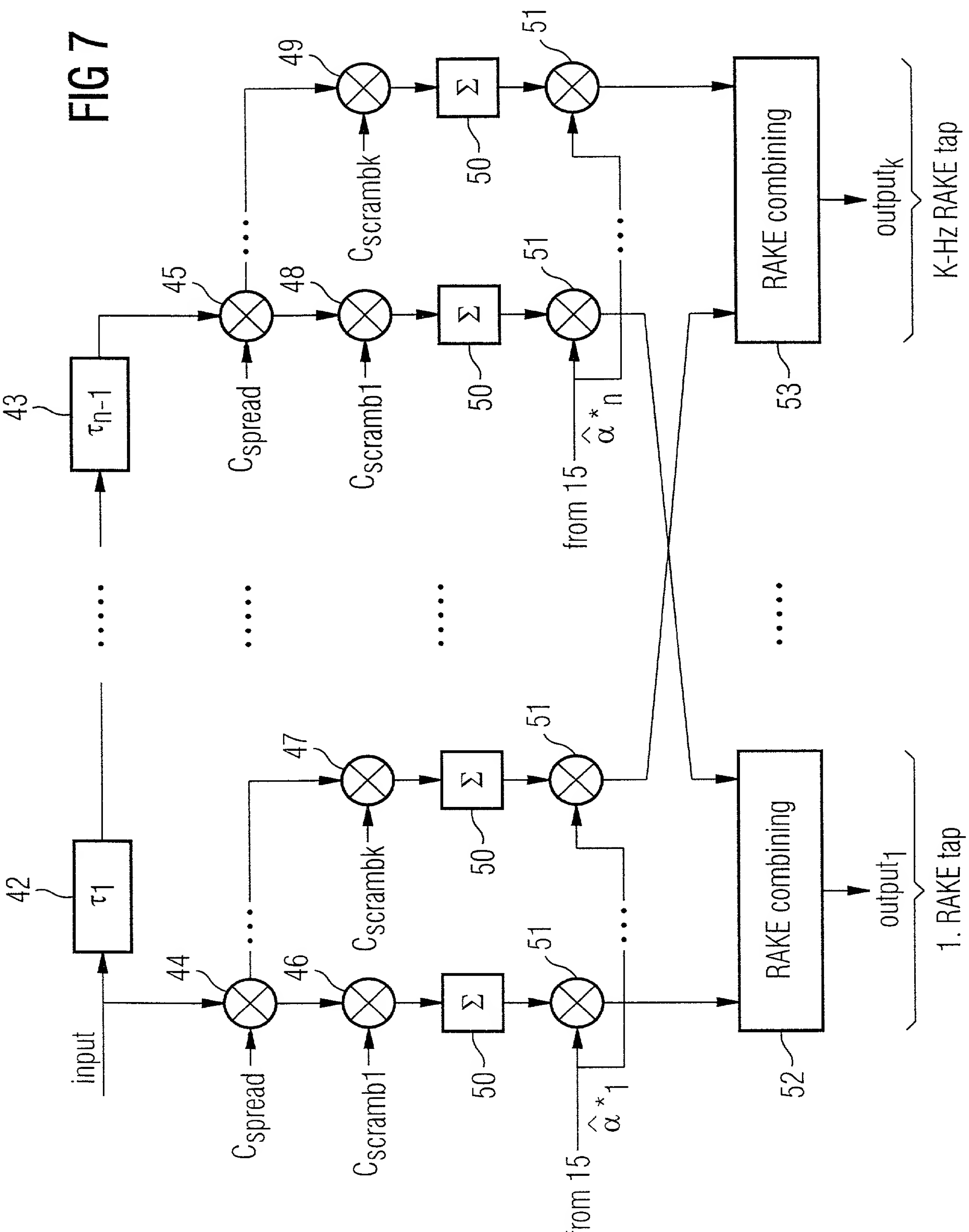


FIG 8



state of the art

FIG 7


input
42
τ_1
43
τ_{n-1}
44
45
46
47
48
49
C_{spread}
$C_{scramb1}$
$C_{scrambk}$
50
51
Σ
from 15
$\hat{\alpha}^*_1$
$\hat{\alpha}^*_n$
RAKE combining
52
53
$output_1$
$output_K$
1. RAKE tap
K-Hz RAKE tap

DECLARATION FOR PATENT APPLICATION (JOINT OR SOLE)
(Under 37 CFR § 1.63; with Power of Attorney)
FROMMER LAWRENCE & HAUG LLP

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention ENTITLED:

Receiver architecture for a multi scrambling code transmission CDMA technique

the specification of which

X is attached hereto.

_____ was filed on __________ as Application Serial No. __________,

with amendment(s) through __________ (if applicable, give dates).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Sec. 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s) [list additional applications on separate page]:

Number:	Country:	Filed (Day/Month/Year):	Priority Claimed: Yes	No
98 120 115.5	EP	23/10/1998	X	

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Sec. 1.56, which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Prior U.S. Application(s) [list additional applications on separate page]:

Appln. Ser. Number:	Filed (Day/Month/Year):	Status (patented, pending, abandoned):

I hereby appoint WILLIAM S. FROMMER, Registration No. 25,506, and DENNIS M. SMID, Registration No. 34,930 or their duly appointed associate, my attorneys, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to file continuation and divisional applications thereof, to receive the Patent, and to transact all business in the Patent and Trademark Office and in the Courts in connection therewith, and specify that all communications about the application are to be directed to the following correspondence address:

WILLIAM S. FROMMER, Esq.
c/o FROMMER LAWRENCE & HAUG LLP
745 Fifth Avenue
New York, New York 10151

Direct all telephone calls to:
(212) 588-0800
to the attention of:
WILLIAM S. FROMMER

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

INVENTOR(S):
Signature: X [signature] Date: X 19.7.99
Full name of sole or first inventor: Jens-Uwe JÜRGENSEN
Residence: D-70736 Fellbach, Germany
Citizenship: German

Signature: X R. B. Stirling-Gallacher Date: X 16/7/99
Full name of 2nd joint inventor (if any): Richard STIRLING-GALLACHER
Residence: D-70736 Fellbach, Germany
Citizenship: British

Signature: __________ Date: __________
Full name of 3rd joint inventor (if any):
Residence:
Citizenship:

[Similarly list additional inventors on separate page]
Post Office Address(es) of inventor(s):
[if all inventors have the same post office address]

c/o Sony International (Europe) GmbH
Stuttgart Technology Center
Stuttgarter Straße 106
D-70736 Fellbach, Germany

Note: In order to qualify for reduced fees available to Small Entities, each inventor and any other individual or entity having rights to the invention must also sign an appropriate separate "Verified Statement (Declaration) Claiming [or Supporting a Claim by Another for] Small Entity Status" form [e.g. for Independent Inventor, Small Business Concern, Nonprofit Organization, individual Non-Inventor].

Note: A post office address must be provided for each inventor.